US Army Corps of Engineers®
Engineer Research and Development Center

Phytoremediation Research within the Department of Defense

Description

Phytoremediation is the use of green plants to remove or contain pollutants from the environment, or render them harmless. It has developed into a promising, cost-effective, and environmentally friendly technology that can be applied to organic and inorganic pollutants present in soil, sediments, surface and groundwater, and air. Phytoremediation usually takes more time than conventional technologies, but it can be applied in many areas that are not suitable for other technologies (difficult to access over land, swampy, remote). Classic remediation methods can cost $100,000 to $1,000,000 per hectare for in situ remediation of water-soluble pollutants. Phytoremediation techniques are estimated to cost $200 to $10,000 per hectare.

Capabilities

Multidisciplinary teams composed of scientists and environmental engineers conduct phytoremediation work on projects related to/situated in, DoD lands (i.e. military installations or Army Ammunition Plants), and Confined Disposal Facilities for dredged material. The projects vary in scale from bench-top to demonstration and full-field scale. The studies focus on Army-relevant organic and inorganic contaminants.

Supporting Technology

Publications in the form of fact sheets, Technical Reports, and journal articles can be found at: http://www.wes.army.mil/el/phyto/index.html

and:http://el.erdc.usace.army.mil/programs.cfm?Topic=serdp&Option=TechTrangrams.cfm?Topic=serdp&Option=TechTran

Benefits

Phytoremediation usually takes more time than conventional technologies, but it can be applied in areas that are not suited for other technologies (difficult to access over land, swampy, remote). Classic remediation methods can cost $100,000 to $1,000,000 per hectare for in situ remediation of water-soluble pollutants. Phytoremediation techniques are estimated to cost $200 to $10,000 per hectare. Phytoremediation can be applied in low to moderately highly contaminated terrestrial and aquatic environments. It is a green technology with low-cost implementation and low maintenance. Proper use often requires an integrated, landscape-scale management plan.

Success Stories

Explosives from groundwater. Short-term studies were performed to determine the feasibility of using constructed wetlands to remove explosives from groundwater, and to assess accumulation of parent explosives compounds and their known degradation compounds in aquatic plants. Tolerance towards explosives was screened, and it was found that submersed plants were generally more sensitive than emergent ones. A small-scale 4-month field study was carried out at the Volunteer Army Ammunition Plant, Chattanooga, TN. In this surface-flow modular system, the influent contained high levels (>2.1 mg L^{-1}) of TNT, 2,4DNT, 2,6DNT, 2NT, 3NT, and 4NT, and the hydraulic retention time (HRT) was 7 days. The performance criteria of U.S. EPA treatment goals for local discharge of 2,4DNT and 26DNT concentration were not met at the end of the experiment, but explo-

sives levels were greatly reduced. Low levels of 2ADNT and 4ADNT were transiently observed in the plant biomass. In contrast, results of two other older constructed wetlands in Milan, TN and Burlington, IA indicated that in these systems treatment goals for TNT and RDX were met most of the time, residues of explosives parent compounds and known degradation compounds in plant tissues were low and/or transient, and in substrates were low. The two latter studies were carried out in cooperation with the Army Environmental Center, the Tennessee Valley Authority, and the CE Omaha District.

Explosives in soil. A three-year project is ongoing in which the capabilities for phytoremediation of distributed source contamination of the soil by explosives on training and testing ranges are explored. A phased approach is followed in which potentially suitable herbaceous plant species are identified; the plants' energetics (RDX, TNT) phytoextraction and phytostabilization capacities are quantified; and explosives containment and leaching in vegetated soil cores are quantified. The results of this project are expected to be directly applicable to both routine and longer term and sustainable military range operations and design. More indirectly, they will help remediation managers and risk assessors in the consideration, design, and implementation of plant-based remedial efforts, and lead to more detailed field remediation trials.

Metals. A greenhouse-scale study was carried out to determine the potential for phytoextraction and phytostabilization of metals from soil contaminated by lead-based paint inFort Lewis, WA, in locally adapted turfgrass, evaluate the influence of differences in soil characteristics on the plant responses, and evaluate the metal leachability of the soil. It was found that in the Ft. Lewis case, the importance of grass vegetation at the LBP-contaminated site would largely lie in serving as soil cover, preventing metals from being released from the site as parts of dust particles or dissolved within surface runoff.

Point of Contact

Dr. Elly Best, 601-634-4246, Elly.P.Best@usace.army.mil